



Wireless versus Wired Line White Paper

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Wireless versus Wired Line

Introduction

Wireless communication has become a part and parcel of the latest world of technology and all the topnotch communication-oriented inventions use this technology in one way or the other. Initially, wireless technology was not very effective and was used only in a few applications. The scenario has now completely changed and it is getting more and more importance in the development of technologies and gadgets that are built by using state-of-the-art technologies.

The main purpose of communications networks makes wireless easier, safe and reliable for people to communicate with others. A number of communications solutions (both wired and wireless) are accessible in the market. Copper and fiber-optic cables are used for safe and secure data transmission. Both have their uses in different distribution issues. Today, wireless technology is taking lead in this regard. There is a rapid increase in the use of wireless technology in utility market applications including distribution automation.

There are many factors that a company has to consider when deciding about the communication technology that it needs to use. The factors may include cost savings, power consumption and flexibility. As there are many options available for users they have to make a decision about the features that they need for their business promotion. Varying companies offer different features and the cost of features also vary from company to company. So, it is necessary to make a list of the requirements and then contact a company that offers the best possible solution to the required issues.

It has to be noted that communication networks are not one-size-fits all, therefore, utility operators have to consider the finances that they can set aside for the communication purposes.

Utility Industry and Wireless Data Radios

Wireless technology has now improved a great deal. It improves distribution automation for smart grid just like we see in recloser control. Manual handling was necessary beforehand, but now reclosers can be employed to re-route electricity over a grid to bypass problem areas. Automation saves time and cost and leads to optimized grid operation. This is the simplest way to improve the smart grid operation.

Data radios are reliable for data transmission purposes and they have many advantages. Here cellular phone coverage isn't optimal, if it even exists at all in rural areas, and data needs to travel under maximum security. Wireless systems use communication gadgets and applications by remaining within its budget.

The communications industry is growing at a very fast pace and experiments are underway to lower the infrastructure cost, increase the gadget performance, improve the time-to-market, increase reliability, easy-to-install technology and introduce cutting-edge technology to go ahead in this direction in mass numbers.

The smart grid market is making rapid progress and the need for economical ways to manage systems is on the rise. It is, thus, the need of the hour to get a communication system that lets a utility operator to communicate in the best possible way.

Comparing Wired and Wireless Solutions

Hi-tech and highly reliable wireless radios are used in military applications where highest precision is needed; they are also employed in industrial applications that are mission-critical. There are many options that a utility operator may employ and it may be wireless and wired communication. Moreover, wired communications may be costly and hard to be maintained. It is pretty hard to repair fiber-optics and replacement is more imminent. The cost of a fiber-optic cable is pretty high in the market. But if an operator is using wireless systems, the cost of repairing this system is pretty low. Moreover, most of the high standard wireless equipment does not require maintenance as it remains in order for many years to come. Moreover, it is possible to detect and address faults in wireless systems remotely. The cost of replacing a wireless system is also decreasing day by day. When a company goes for a wired option, it has to purchase the requirement of cables in terms of their measurement in feet, whereas a wireless radio system is priced in terms of miles. For example, a topnotch radio system can communicate perfectly across 60 mile links. However, wired line options such as fiber optics makes sense, if available, if utility operators can use dark fiber from a 3rd party provider.

Features of Wirelessly Communicating Systems

Strictly speaking about wireless communication systems, a utility operator has to consider the advantages that it involves for their company. The major merits of these systems may include:

1. It is quite easy to install topnotch wireless first-rate data radios for a communication system. No expensive or trenching equipment is required to install this equipment as it does not need wires. There is no need to install a specific type of network topology, so, users start working instantly when they get their communication and network connections. The master and remote radios can handle every issue in this regard.
2. Cell and satellite phones rely on carrier-based technology and service providers. Users have to pay monthly bills for using these services. This billing adds to the cost of the system. Moreover, the cell phone type of system is not backward compatible. If a utility user installs a new system, it is very costly as the new technology is always pricey. It also adds to the expenses if a network requires new data transmission lines in remote areas where it is not financially feasible to spread wires. 3rd party service providers do not provide priority of service.
3. Technology is becoming more and more complex and it is pretty hard for a single communication system solution to resolve all the issues that a company faces. So, the best option will be to use a hybrid network for handling data communication systems. It is actually a blend of many reliable and most advanced technologies. The hybrid type of network may include a mixture of data radios, fiber-optic, satellite, cell-phone, and other technologies. It is a cost-effective solution to the needs of companies and it is more compatible with different types of networks. It uses less power and users have to pay monthly fee after customizing their needs.
4. Another important factor is that of copper theft. It is a fact that the incidents of the copper theft are increasing day by day in the whole of USA and it is one of the many reasons that the wired technology is becoming dearer and dearer. There is no such involvement of copper wire when a company uses wireless communication system.

Communication Loss Is More Dangerous Than Power Failure

In the smart grid industry, thieves have also become crafty enough not to indulge in the copper wire theft from high voltage lines; they would rather go for stealing it from communication lines. The power failure only causes electric appliances to be shutdown whereas the communication failure may lead to the shutdown of everything where data transmission is required. Although copper wire infrastructure of technology is traditionally taken as one of the best ways to communicate, the need for wireless communication is increasing due to the looming theft problems. Communication systems providing companies are shifting their interests towards wireless technologies that have become equally useful and the quality of this communication system is also on the rise. Moreover, wireless systems have developed security tactics and are less prone to be stolen away. Operators may also use remote devices to handle various communication networks.

Security Issues for Wired and Wireless Communication Systems

Traditional wired data communication systems are quite different in its infrastructure from wireless technology. Wireless uses radio frequencies (RF) through its electromagnetic waves. As no physical contact between cables is required in case of wireless communication, the waves travel in a non-discriminatory way. To access the data from wired system, there must be a physical wire-to-wire contact, but to access data from wireless technology, there is no need to have physical contact between wires.

Wireless Is More Resilient

HedyLamarr (an Austrian actress) and George Antheil co-patented “Secret Communication System” in 1940. The system allowed them to radio control torpedoes so that they must not be discovered, decoded, or blocked. The system worked through frequency hopping and rapidly changed radio frequencies so that the radio spectrum literally hops and the others are unable to locate, decipher or block it. The idea was good but it was far before its time; it was implemented in 1962 in military ships of the U.S.A. Now, this wireless communication system is named as Frequency Hopping Spread Spectrum (FHSS) and it has gained a lot of importance in the U.S. army matters.

FHSS is a wireless system that has proved its worth for its resilience. It may be applied confidently to avoid “jamming” or any other kind of impairment. These signals continue hopping and do not stay at a specific frequency for long. They adopt the “multipath” phenomenon and use small amounts of radio spectrum and “hop” to other frequencies rapidly. It, thus, becomes pretty hard to get “Denial of Service” problem on this FHSS system. Topnotch wireless radios employ FHSS system make it sure that data remains secure for distribution automation and utility application.

Wired communication is related with high cost, copper theft, difficult procedure of installation, high repairing cost and so on. Most of the contemporary departments, including military based installations, are turning their attention towards wireless solution due to the latter’s reliability, long-range, viability and affordability. In addition to all the above-mentioned perks, wireless solutions are cost-effective.

The FHSS technology offers hardcore enhanced security to let users gain trust in the wireless technology just like they trusted in the wired one. The wireless technology has become even more secure due to FHSS system and professionals of the field are going ahead to make it even more reliable, viable, trustworthy, secure, cost-effective, easy-to-install and risk-free.

Revolutionary Changes in the Electric Power System Distribution

Wireless communication is active in numerous fields and it has brought a lot of revolutionary changes in the lives of people. It has changed the overall scenario and has modernized different types of industries and power-related issues. It has also improved efficiency and reliability. The examples of this new type of communication are visible in many systems including the electric power system. The wireless communication has brought revolutionary changes in the electric power system distribution in its:

- Operations: with wireless communications technology, it has become possible to control and monitor networks in the electric power system. Sensors play a vital role in this regard and they make it possible for the remote managers to manage the electricity supply, billing, usage and other statistics related to power system.
- We can further classify these sensing and control networks according to their location.
 - Firstly, there are Home Area Networks (HANs). This network links the appliances and a central controller that are being used inside a home. This network helps to monitor and exchange the metering networks and works as a communication channel for its operational signals. This metering infrastructure is also responsible of carrying the price-related incentive signal – a utility that is used to implement the demand response.
 - Wireless networks allows Distribution Automation.
 - Wireless networks allow experts to monitor and control Substation Automation. Here, the main purpose of the control network is to check circuit current and voltage. Wireless devices play a vital role in performing physical surveillance.
 - Wireless works with transmission systems.
 - Wireless technologies are deployed at the most difficult locations where the wired sensors cannot reach. They improve the surveillance capability through motion detectors and video cameras.
 - Wireless control network handles the financial operations including energy settlements, billing and accounting.

With the advent of newer technologies, it is becoming harder for traditional control systems to monitor and control the communication and architecture of systems. No single system can be implemented to handle this issue. For instance, an electric control system that is fit for Texas may not be suitable for New York. There is always a need for scalability, complexity and flexibility.

Here, we mean to analyze the capabilities of wireless and wired communication so that to finally know about the most suitable solution for the surveillance of the electricity issues.

The Usage of Wireless Communications to Monitor the Electric Power System

Wireless communication is flexible and cost-effective in the maintenance and execution as compared to wired technologies. Its use is as simple as 1, 2, and 3 and there is no need of conduits and trenches. Wireless networks usually use middle and last mile technologies and it can be deployed anytime and anywhere. The most important aspect is that they do not need

much energy to perform their functions. It is pretty easy to locate a wireless sensor. It is also easy to deploy additional sensors whenever the need be there.

Electric Power System Communication Examples

A smart grid framework (September 2009) at the National Institute for Standards and Technology (NIST) shows a conceptual flow of information to monitor transmission, residential and their distribution networks.

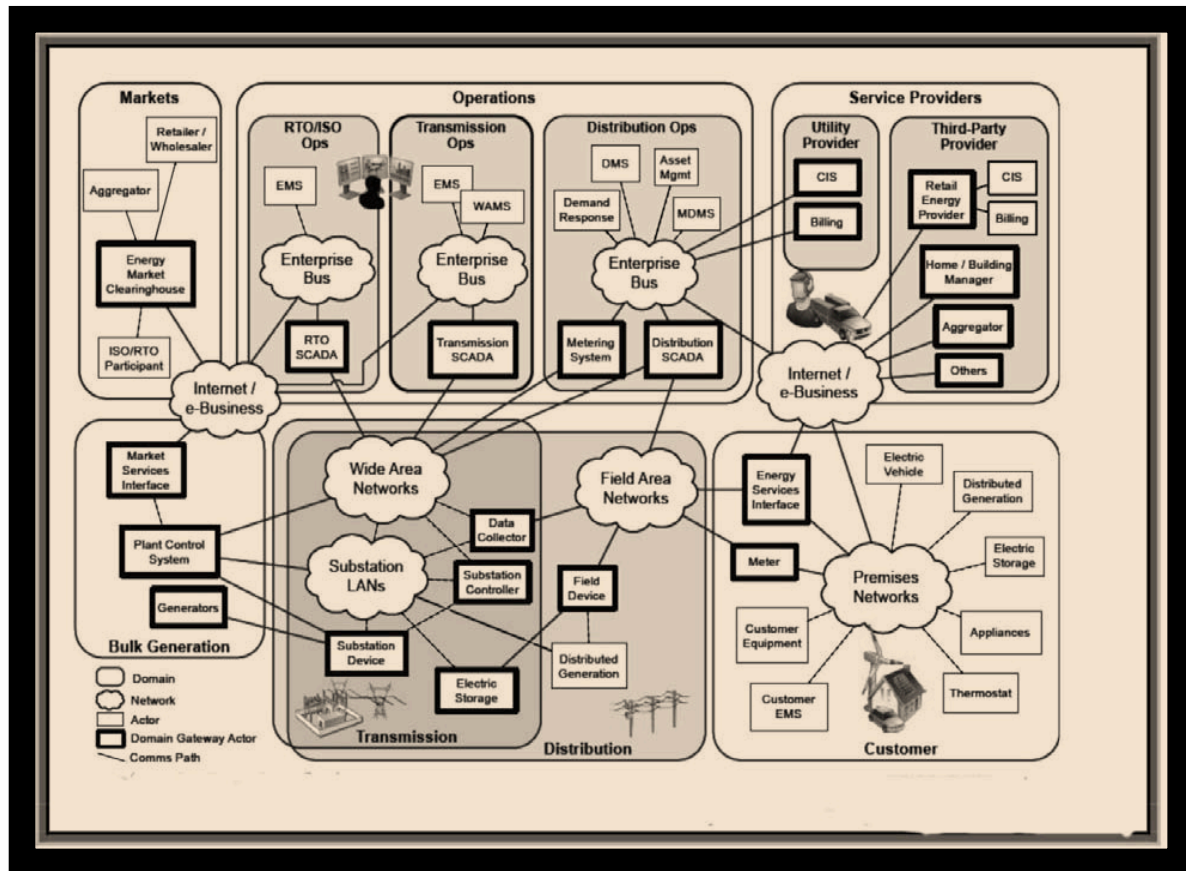


Figure 2.1 NIST Framework1. 0, in September 2009

The command and control system of data communication must be secure enough to gain the confidence of users. The billing information, the personal information, customers' identity, etc, must remain confidential and secure under the working of this system. The following Table 1 gives a knowhow about terminology of the system so that readers may grasp things with confidence. Wireless communications is the cornerstone of Electric Power System Communications in today's Smart Grid World.

The Electric Distribution System Communication

The well designed, tailored and well-equipped distribution system is key to bring revolutionary changes in the electric power system. Mostly, the distribution systems are not monitored and controlled with minute details as a lot of extra money was initially involved in this process. But with the advent of remote and wireless technology, it is now possible to do so. It is possible now to manage the distribution system by automating them to maximum limits.

The low and medium voltage power delivery systems are termed as “distribution automation”. Their functions are:

- Balance loads for maximum system operation
- Collect load data for better system planning
- Control power system voltage
- Detect outages
- Detect stolen energy
- Manage customers’ loads
- Monitor the power system performance
- Read customers’ meters periodically
- Reconfigure the system after detecting a fault

We may geographically divide distribution automation and communication into separate parts:

1. Low-voltage feeders and transformers, for example, customer’s meter.
2. The distribution substation, transformers, buses and breakers to provide power to substations
3. The customer’s side meter equipment for load control

Here, the communications for electric distribution system occur at the following premises:

Communication in the Customer’s Premise

The main concern of a customer is to have a smart grid deployment at their premise in the form of Smart Grid Nodes (SGNs) so that to monitor small and large appliances used for ventilation, heating and air conditioning. The household devices may include computers, entertainment devices, water heaters, plug-in vehicle, smart meter and chargers. SGN and smart meter communicate with each other to exchange information and to collect schedule for distribution metering rates. Even low data rates of communication will be okay in this regard. Even from moderate-to high-latency communication is allowed in this instance. The smart meters must be able to differentiate between the SGNs of different houses.

Communication between a Customer's Premises and Control Center for Local Distribution

The purpose of this application is to connect in-premise smart grid network to power utility. It interprets, summarizes and aggregates data from the premise and fetches it to the local power utility. Both wired and wireless options of communications are valid here, the reason being that even low-to-moderate data rate is allowed for it. It contains billing data so that there must be no compromise on the data that finally reaches the destination at local distribution center.

If the application is using wireless communication mode, the expected interferers may include wireless and cellular networks, radio frequency remotes, Bluetooth, microwaves, etc. The communication options may include wired networks (cable modem, DSL, power line), and wireless networks like LTE.

Communication in Distribution System and Substation

The exchange of information between a substation and distribution system aims at measuring voltages, distribution station and currents that are associated with circuit breakers, transformers and switches. Here, the main concerns are physical security monitoring equipment including video cameras, motion sensors and so on. The application needs highly reliable low-to-moderate data rates, and moderate reach of 1 to 5 square miles.

Moderate communication latency may be there in this instance. Here, both wired (in the form of Ethernet) and wireless in the form of LTE and/or WiFi are allowed.

Bulk Generation Plant Communication

There is always the need for a precise communication system for bulk generation plants as it may contain a lot many generation units. Several hundred sensors are needed in each of the plants to measure air, water, temperature, outflow, the resultant production of energy and so on. The intrusion sensors, motion sensors, video cameras, etc, are needed to monitor the security of the plant.

The monitoring and surveillance may be done through the use of various wireless technologies with their sensors.

Operations Center and Transmission Network Communication

Keeping the Electricity system example live, we can see that a communication link is necessary between transmission network and operations center. Here moderate data rates, high reliability and long coverage are necessary. The wired network would mean a lot of expenses on spreading wires and maintaining a network. LTE, WiMAX, 3G/4G networks can do the same job with great precision and accuracy.

Operations Center and Bulk Generation Plant Communication

Another requirement of the electricity distribution system is the communication between bulk generation plants and their operation center.

Here, wired as well as wireless communications are possible. For wired communication, a T1 line or faster link such as dark fiber can be used. The LTE, WiMAX and 3G/4G networks may also be used to operate as a lower cost replacement communication link.

Wireless Technology Matrix

Life expectancy, latency, resilience, scalability, coverage, bandwidth and security are the criteria for choosing the wireless communications apparatus and technology.

- Latency is the round-trip time that two parties take to communicate with each other. The overall latency of a network determines its good put.
- Bandwidth is the capacity of a channel to transfer information.
- The resilience of a wireless network shows its resistance to both random and directed interference.
- Wireless networks have developed into highly secure networks due to the advancements in the communications technology. It includes a resistance to messages tampering, information confidentiality, and prevention of unauthorized access, mutual authentication of servers and clients, and so on.
- A wireless network has a smart grid and the ability to evolve utilizes that can rapidly provide information about the remote and far-flung areas and installations. A small wired network would not be able to do so.

The fault tolerance level of the wireless technology has also increased to a great deal as the topnotch discoveries are being made in this context on regular basis. The wireless technology is, thus, taking lead and it will prevail in the long run due to limitless advantages that it offers to common men, businesses and communication companies.

About iWire365

iWire365 is a Dallas based organization that combines wireless telecom infrastructure and business/IT application services, focused strictly on the rural cooperative and municipal utility markets. The iWire365 model mitigates capital and technology risks, while providing the lowest possible cost of service and the highest level of customer satisfaction.

For more information about our solutions and capabilities, please contact us today.

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